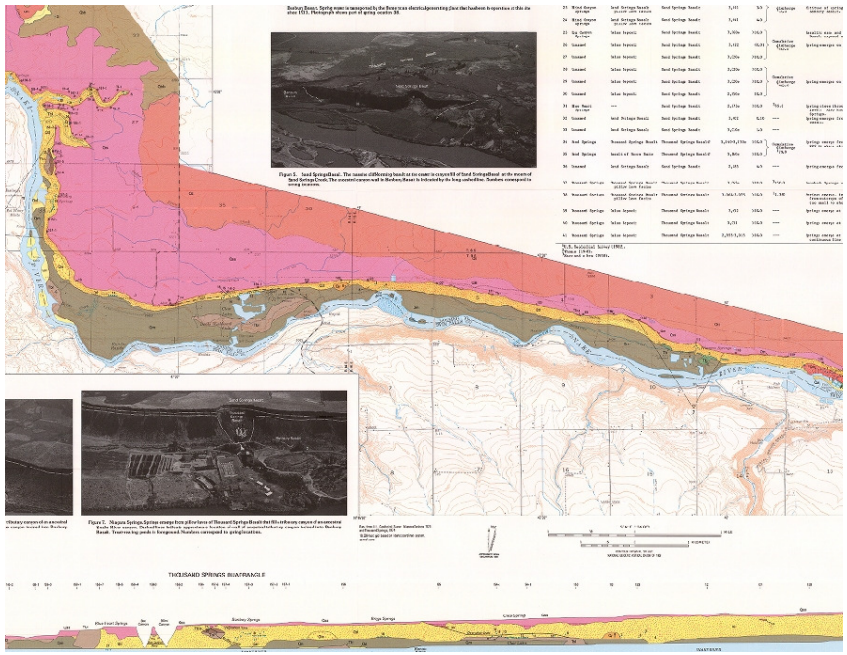
Impact of Adjustments to Covington & Weaver

Allan Wylie IDWR

Adjustments to Covington & Weaver

- What adjustments have been made
- How Covington & Weaver is used
- The impact on ESPAM2

Covington & Weaver

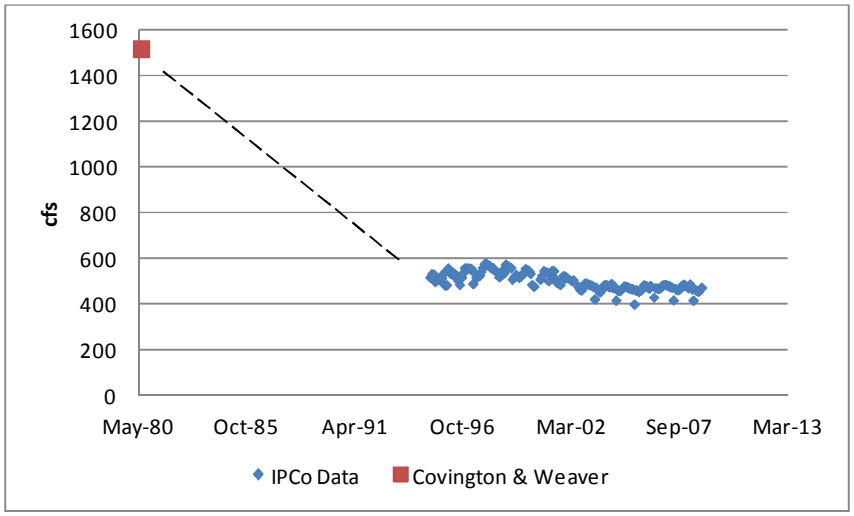


- USGS (1989) Geologic maps of Snake River Canyon in Magic Valley
- Include location, elevation, and discharge of springs

What is Covington & Weaver

- Sources for Covington & Weaver spring discharges
  - Visual estimates made during mapping (1980s?)
  - Nace and others (1958) which reported 1899-1947 data
  - Thomas (1968) which reported 1948-1967 data
  - USGS (1974) which reported 1966-1970 data
  - USGS (1982) which reported data from water year 1981

Adjustments to Covington & Weaver



- ESPAM1.1 transient spring targets were intended to represent typical seasonal fluctuations
- ESPAM2 spring targets are intended to represent total discharge from model cell
- When developing ESPAM2 spring targets discovered issue with Thousand Springs Power Plant
- Decline between 1980 and 1995 seemed excessive

Adjustments to Covington & Weaver

- As a result of Jones/SeaPac call we examined the relevant ESPAM2 cells
- Covington & Weaver did not have enough spring water to supply the size of fish farms in cell containing Jones

Adjustments to Covington & Weaver

- Replace 3 cfs mapped by Covington & Weaver with 73 cfs measured by IDWR in 1973.
- Replace 0.1 cfs mapped by Covington and Weaver with 6 cfs, based on peak reported diversions at Spring Creek Spring between 1995 and 2008.

Adjustments to Covington & Weaver

- Jennifer Sukow examined other springs comparing Covington & Weaver discharges with water rights, where available and did not find any more significant issues

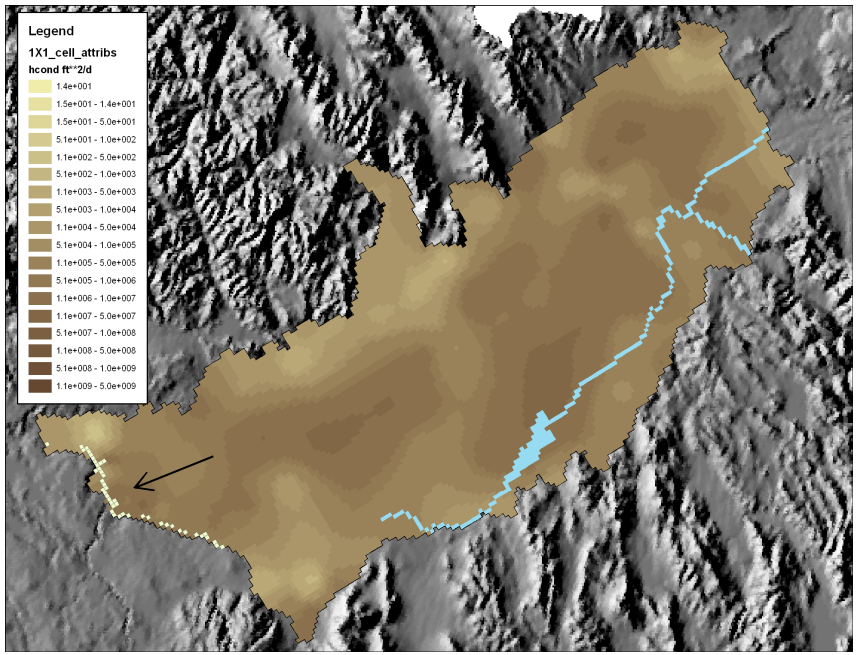
How Covington & Weaver is Used

Reach	C&W cfs	Modified C&W cfs
Devils Washbowl-Buhl	1075.70	1075.70
Bulh-Thousand Spgs	1699.62	1699.62
Thousand Spgs	1879.01	895.01
Thousand Spgs-Malad	201.61	277.56
Malad	1199.00	1199.00
Malad-Bancroft	97.26	97.26
Total	6152.20	5244.15
Avg gain Kimberly-King Hill		6017.24

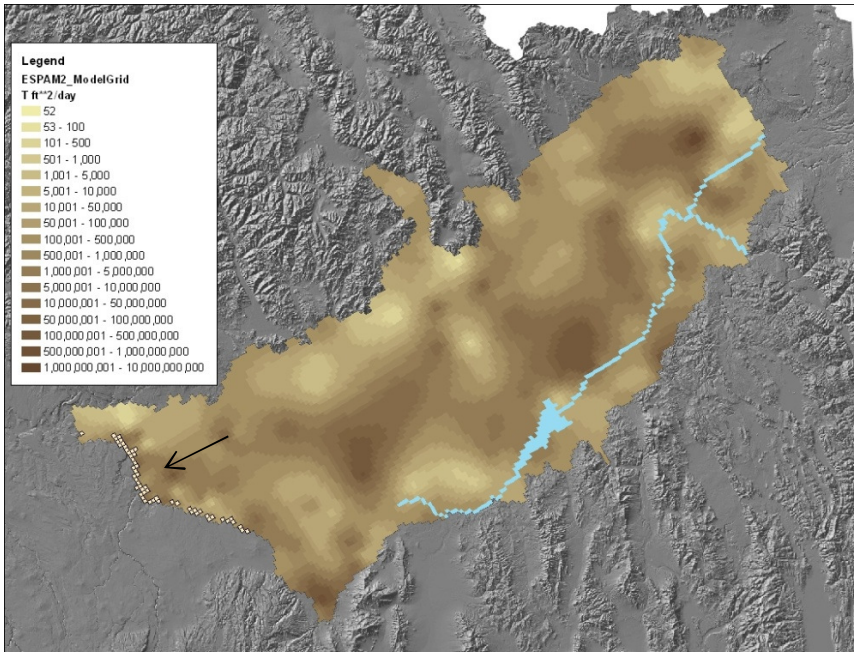
- ESPAM1.1
  - Covington & Weaver was used to develop ratio to apportion total spring discharge to reaches
- ESPAM2
  - Covington & Weaver used to provide ranking for spring cells lacking transient targets (C springs)
  - Model still must discharge ~ 6000 cfs below Kimberly so 984 cfs that used to go to Thousand Spgs now must go elsewhere
  - Thousand Springs was ~31% of total discharge, now 17% of total discharge

Impact of Changes

V 1.1



Preliminary V 2



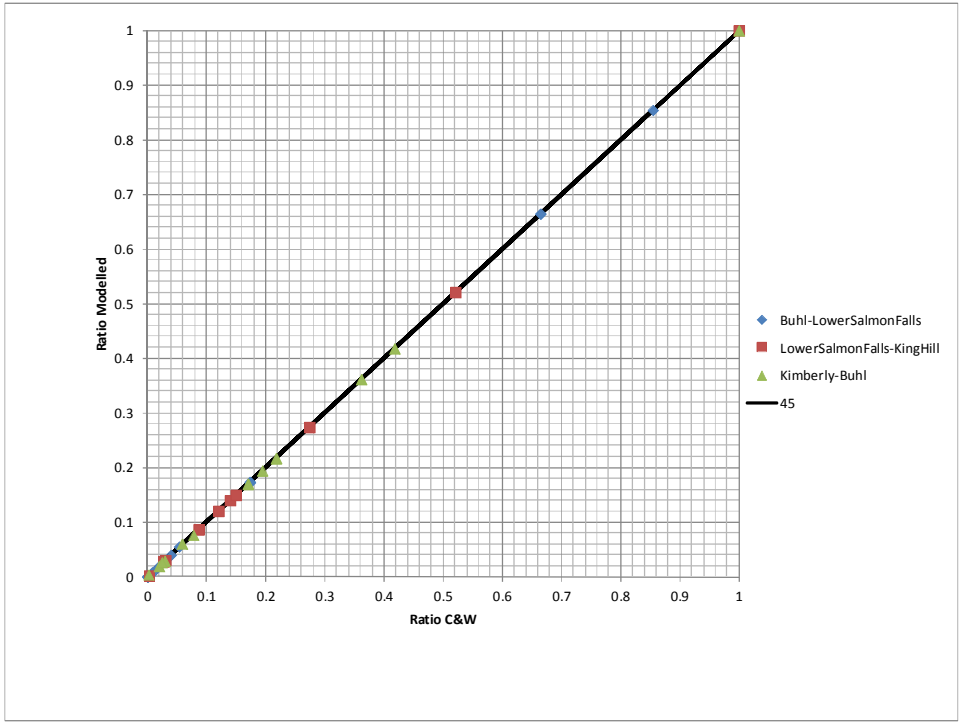
Impact of Changes

- 984 cfs formerly going to Thousand Springs must go somewhere
  - Can not go to A&B springs
  - 76 cfs goes to Thousand – Malad (Jones)
  - 908 goes to C springs
- Adjusted Covington & Weaver springs don't total 6,000 cfs
- Class C springs have to significantly exceed Covington & Weaver estimates

Adding More A&B Targets Makes This Worse, not Better

- Thousand Springs adjustment removed 984 cfs from the Thousand Springs cell
- MODFLOW must match Kimberly-King Hill gains (~ 6,000 cfs) from springs, 984 cfs excess can only be assigned to class C springs
- Before Rangen, National Fish Hatchery, Niagara, Sand Springs, and Three Springs were A&B Targets
  - 984 cfs excess not going to A&B springs
  - 42 class C cells
  - 23.4 cfs extra per class C cell
- Move Rangen, National Fish Hatchery, Niagara, Sand Springs, and Three Springs to A&B targets
  - 908 excess not going to A&B springs
    - 76 cfs went to Three Springs adjustment
  - 36 class C cells
  - 25.2 cfs extra per C cell

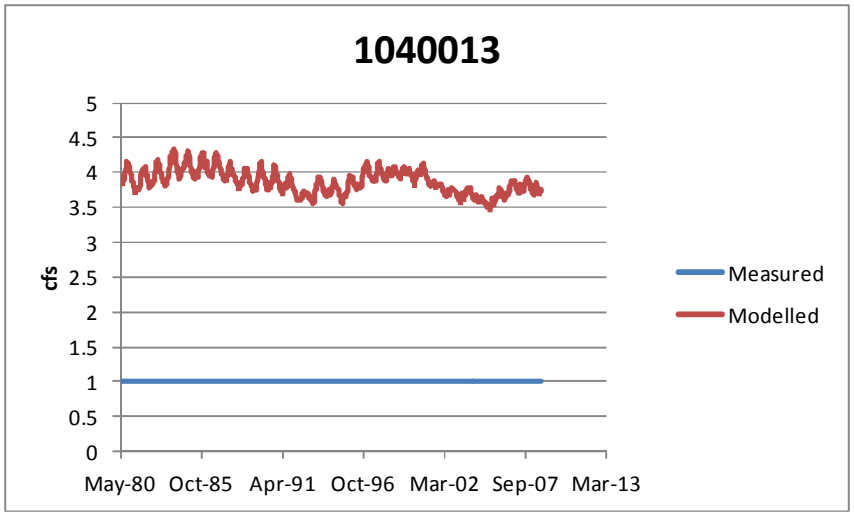
C Spring Ratio Targets

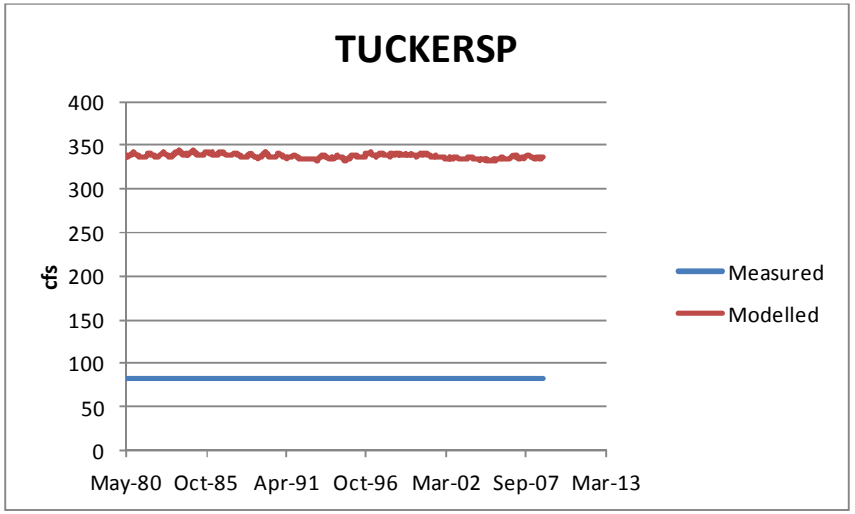


- Targets are ratio
- Allows for water excess
- Model discharge to class C cells is on average 4 x larger than C&W estimate

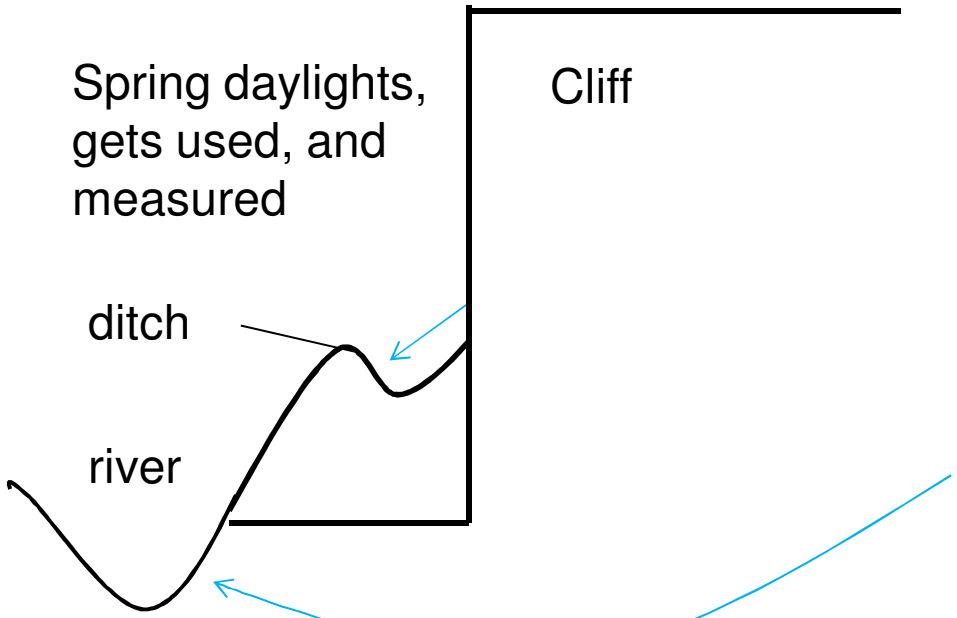
Reach	Reach Total (cfs)	Spring Cell	Model avg (cfs)	C&W (cfs)	ratio
		1057020	2.87	1.75	1.64
		1058020	1.01	0.6	1.69
		ELLISON	7.06	4.3	1.64
		1059021	0.06	0.02	3.18
		1059022	1.3	0.8	1.62
		1061023	16.91	10.3	1.64
		1062023	3.28	2	1.64
		1064026	6.11	3.72	1.64
		1065027	3.66	2.24	1.63
		1068029	0.33	0.2	1.63
		1069029	0.49	0.3	1.62
Kimberly-Buhl	26.5	1070030	0.45	0.25	1.78
		1037014	27.93	6.73	4.15
		BIRCHCR	8.82	2.23	3.96
		1038014	87.83	21.83	4.02
		BIGSP	435.03	107.68	4.04
		1040013	3.85	1.01	3.81
		1040014	14.13	3.5	4.04
		TUCKERSP	338.1	83.7	4.04
		1045011	0.16	0.1	1.59
		1045012	20.12	5	4.02
		1047011	15.38	3.7	4.16
		BANBURYSP	509.17	126	4.04
		1050014	0.01	0.02	0.67
Buhl-Lower Salmon Falls	361.5	1051014	0.03	0.03	0.94
		BANCROFT	81.75	17	4.81
		1030013	5.29	1.1	4.81
		1031013	24.52	5.1	4.81
		1031014	15.21	3.16	4.81
		1032013	4.85	1	4.85
		1032014	48.08	10	4.81
		1033013	0.38	0.1	3.76
		1033014	91.35	19	4.81
		1034014	175.49	36.5	4.81
		1035014	21.15	4.4	4.81
Lower Salmon Falls-King Hill	102.8	1036014	26.24	5.46	4.81
Total =	490.8		1,972.2	490.8	

C targets


1040013
cfs
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
May-80
Oct-85
Apr-91
Oct-96
Mar-02
Sep-07
Mar-13
Measured
Modelled


TUCKERSP
cfs
400
350
300
250
200
150
100
50
0
May-80
Oct-85
Apr-91
Oct-96
Mar-02
Sep-07
Mar-13
Measured
Modelled

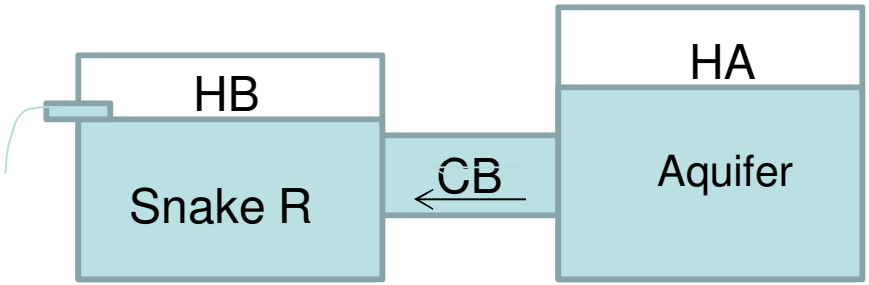
Underflow


Spring daylights, gets used, and measured
Cliff
ditch
river
Part of discharge goes directly into the river and is not measured

Proposal

- Account for underflow with General Head Boundary (GHB)
  - Will show up as separate water budget item in MODFLOW output
  - Use specific targets to get underflow where we know it exists
    - Thousand Springs, Crystal Springs
  - Evenly spread remainder
  - Targets will be average discharge for model period

General Head Boundary



- GHB
- QB = CB(HB-HA)
  - QB = flux across boundary
  - CB = boundary conductance
  - HB = water level in Snake River
  - HA = aquifer level

Crystal Springs Underflow

- March 2011 USGS gaged Snake River above and below Crystal Springs
- Gain = 450 cfs +/- 45.90 cfs
- Typical Crystal discharge in March = 299 to 370 cfs
- Underflow:

  450 cfs – 334 cfs = 116 cfs

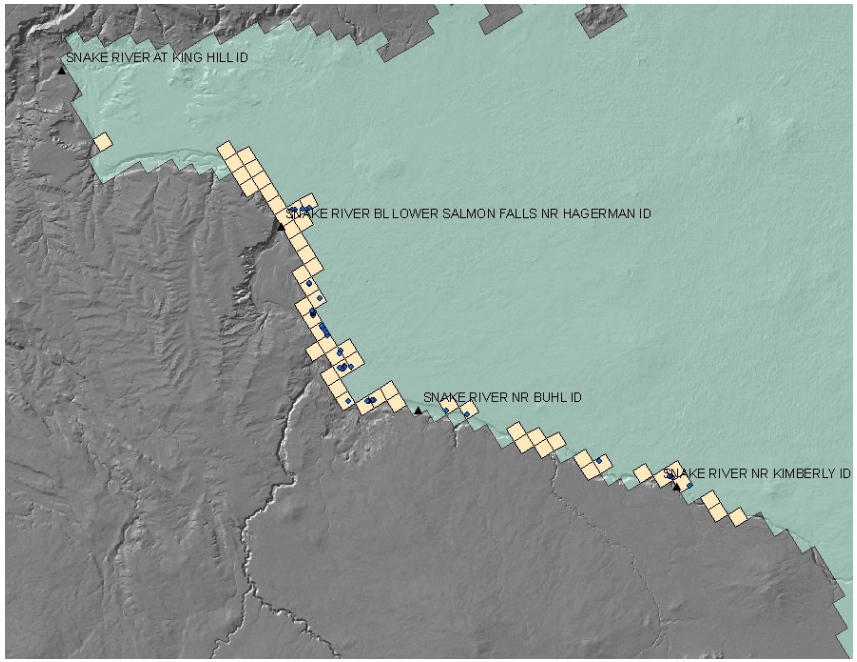
Thousand Springs Underflow

- 14 USGS measurements at times when we have calibration data
- Assuming that underflow is the difference between USGS measurement and the sum of Thousand Springs cell and Magic Springs and the 5 cfs C&W estimated for cell 1045012
- Calculated underflows range from 224 to 765 cfs,
  - Average underflow = 494 cfs

River Reach Gains

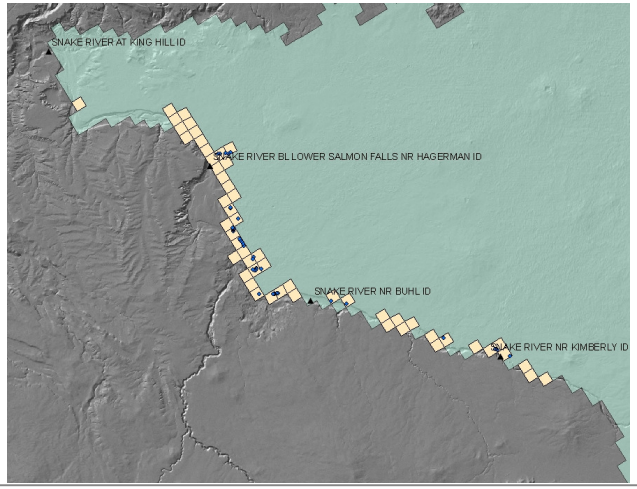
- Reach gains have Southside underflow and returns subtracted out
- Reach gains have Northside returns subtracted out

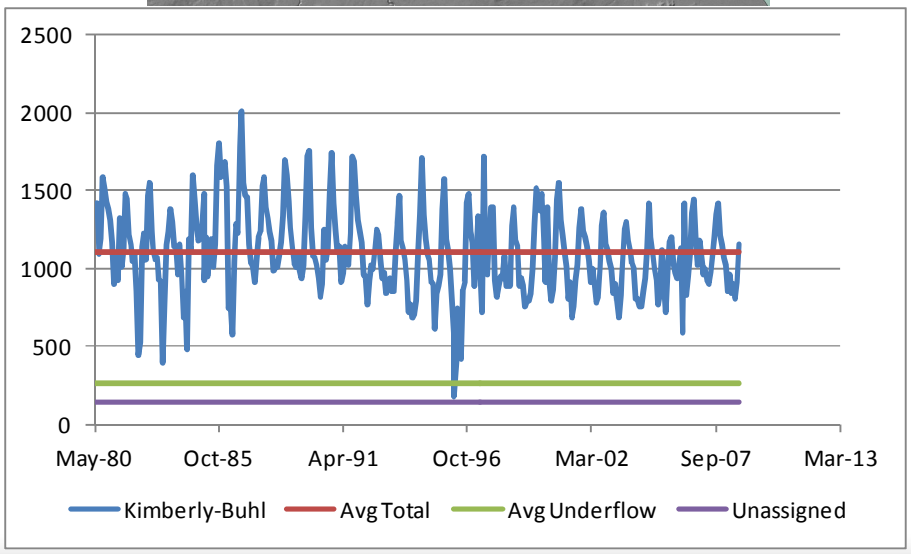
Calculation of Underflow



- Under flow = Average gain – (Average A&B springs + C&W springs)
- Underflow assigned GHB
- Assign underflow according to gaged river reaches
  - Kimberly – Buhl
  - Buhl – Lower Salmon Falls
  - Lower Salmon Falls – King Hill

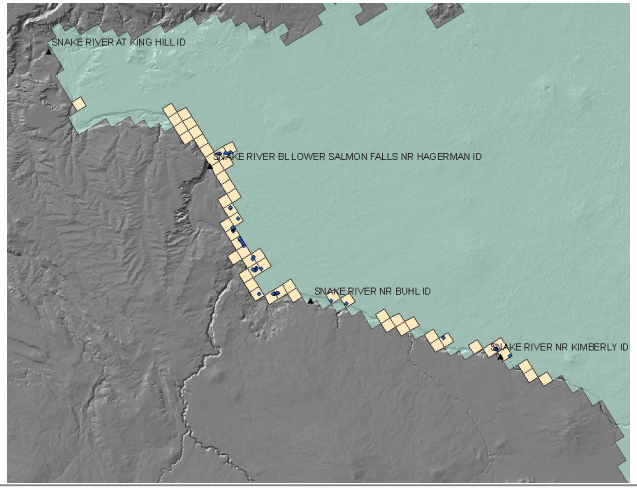
Kimberly - Buhl

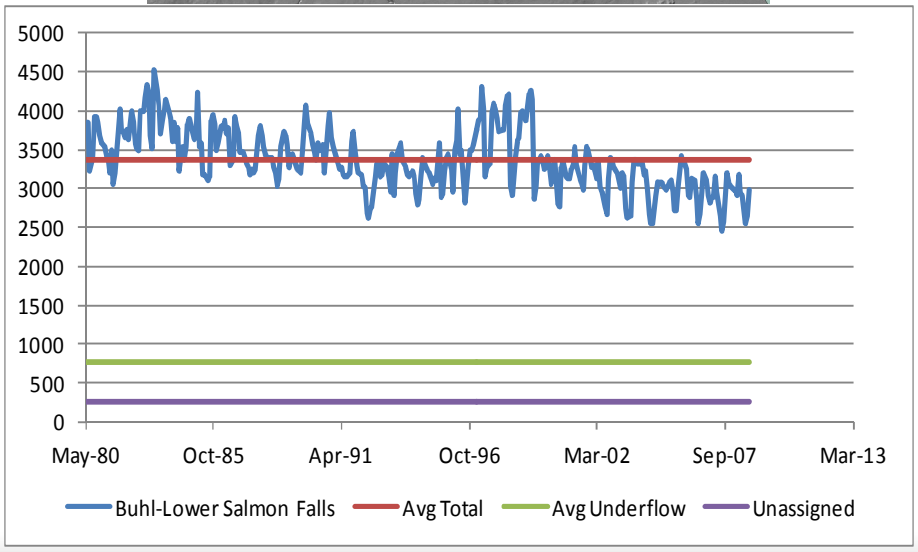




- Avg gain = 1104.5 cfs
- Avg A&B spg = 813.5 cfs
- Sum of C cells = 26.5 cfs
- 1104.5 – (813.5 + 26.5) = 264.5 cfs
  - Crystal underflow = 116 cfs
  - 264.5 – 116 = 148.5 cfs
  - 16 cells in reach after removing Crystal cell
  - 148.5/16 = 9.3 cfs/cell

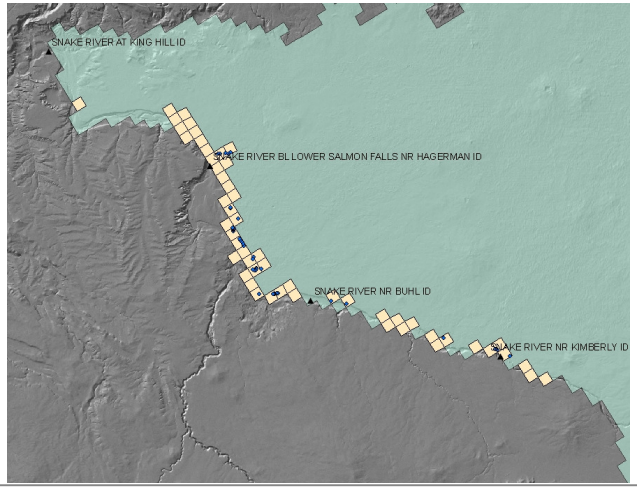
Buhl – Lower Salmon Falls

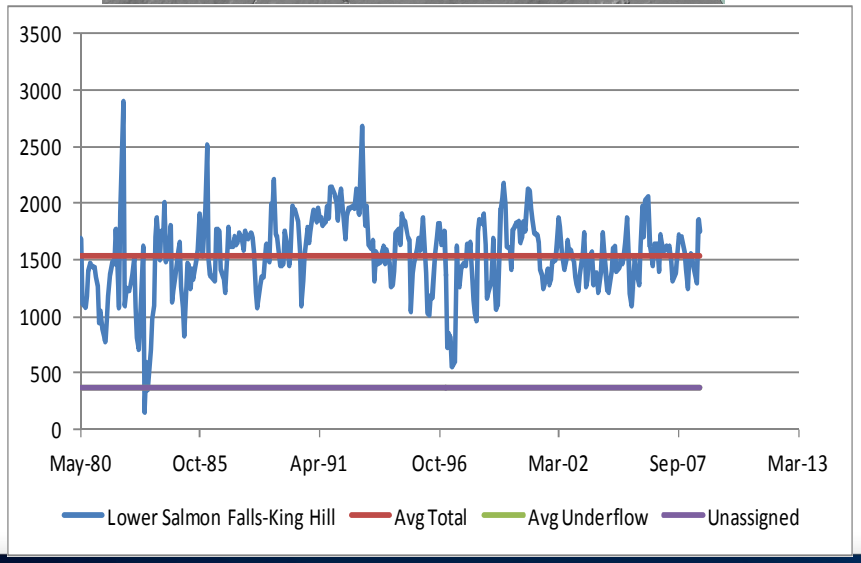




- Average gain = 3370.4 cfs
- Average A&B springs = 2101.4 cfs
- Sum of C cells = 361.5 cfs
- 3370.4 – (2101.4 + 361.5) = 907.5 cfs
  - Thousand & Magic underflow = 494 cfs
  - 907.5 – 494 = 413.5 cfs
  - 22 cells in reach after removing Thousand & Magic cells
  - 413.5/22 = 18.8 cfs/cell

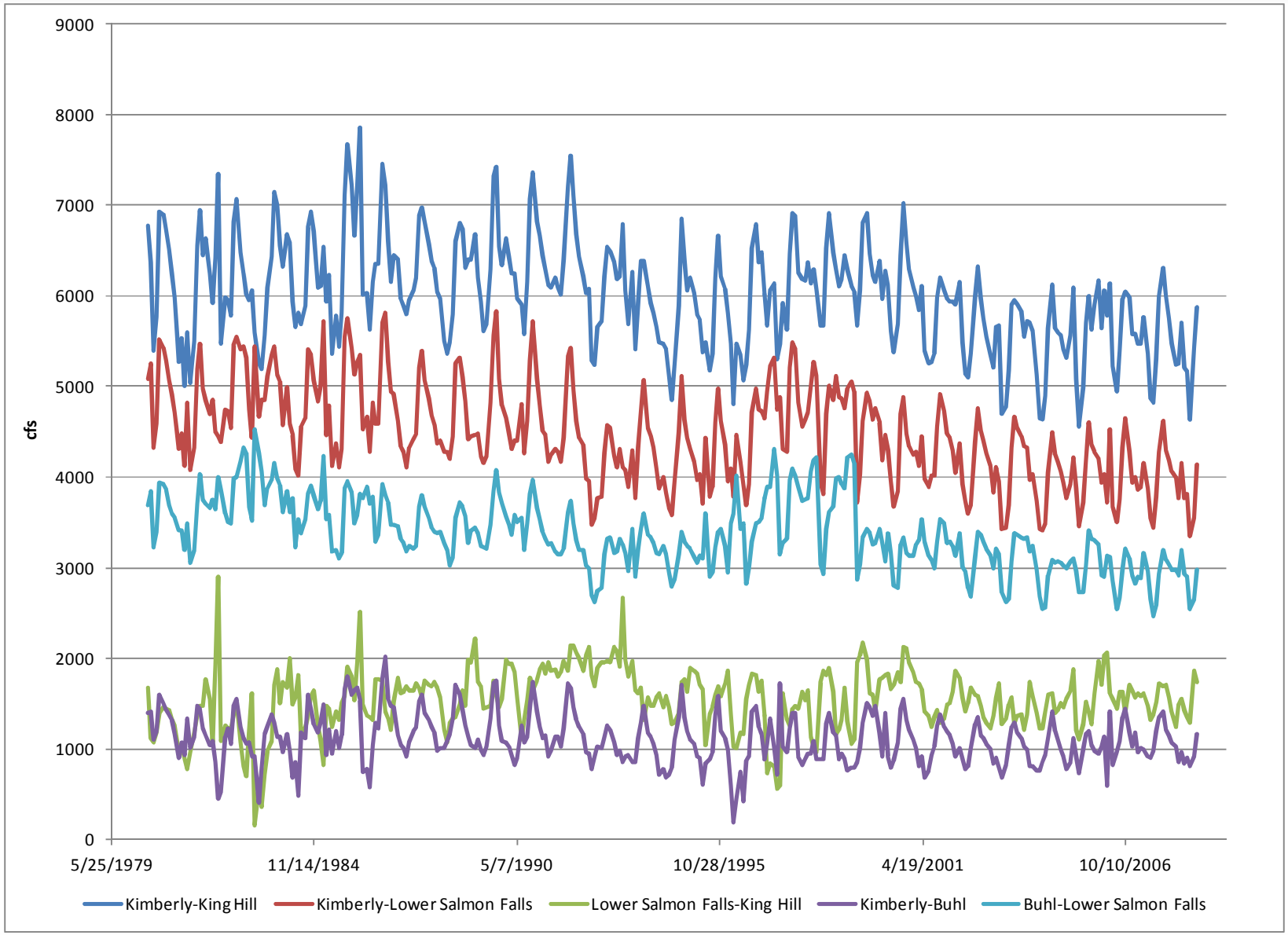
Lower Salmon Falls – King Hill



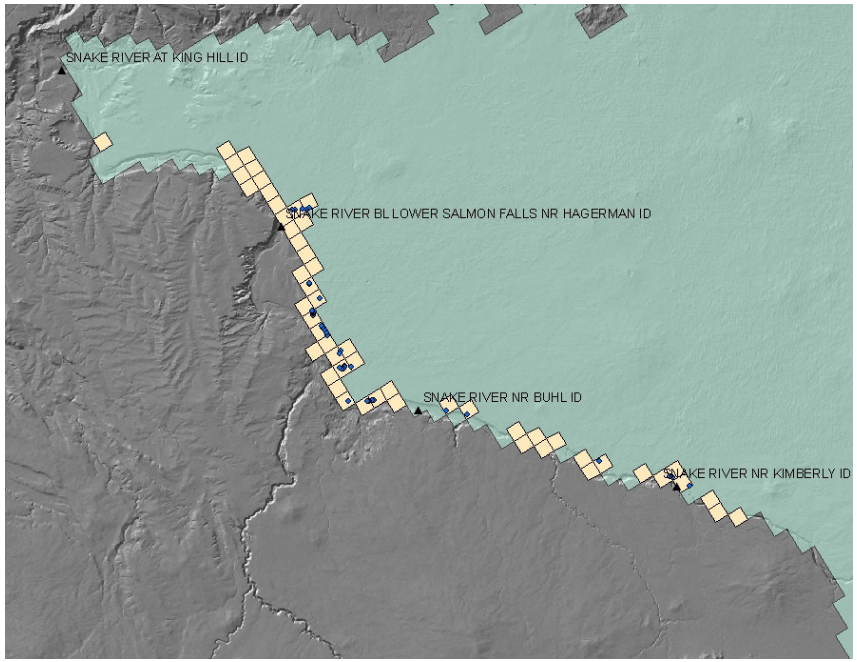


- Average gain = 1538.7 cfs
- Average A&B springs = 1070.5 cfs
- Sum of C cells = 102.8 cfs
- 1538.7 – (1070.5 + 102.8) = 365.4 cfs
  - 13 cells in reach
  - 365.4/13 = 28.1 cfs/cell

END


9000
8000
7000
6000
5000
4000
3000
2000
1000
0
cfs
5/25/1979
11/14/1984
5/7/1990
10/28/1995
4/19/2001
10/10/2006
Kimberly-King Hill
Kimberly-Lower Salmon Falls
Lower Salmon Falls-King Hill
Kimberly-Buhl
Buhl-Lower Salmon Falls

Preliminary



- Kimberly-Buhl
  - 264.7 cfs underflow
  - Crystal = 116
  - 148.7 cfs/16 cells = 9.3 cfs/cell
- Buhl – Lower Salmon Falls
  - 761.7 cfs underflow
  - Thousand/Magic = 494 cfs
  - 267.7 cfs/22 cells = 12.2 cfs/cell
- Lower Salmon Falls – King Hill
  - 365.5 cfs underflow
  - 13 cells = 28.1 cfs/cell